International Application No.: PCT/JP2004/007932
International Filing Date: June 7, 2004
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Title of the Invention: CHIP TYPE LED

DECLARATION

I, kyoko NAKAGAWA, hereby declare:

that I am a translator belonging to KYOWEY INT'L of 2-32-1301 Tamatsukuri-Motomachi, Tennoji-ku, Osaka, 543-0014 Japan;

that I am well acquainted with both the Japanese and English languages;

that, for entering the national phase of the above-identified international application, I have prepared an English translation of the Japanese specification and claims as originally filed with the Japanese Patent Office (Receiving Office); and

that the said English translation corresponds to the said Japanese specification and claims to the best of my knowledge.

I also declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statements is directed.

Declared at Osaka, Japan on February 27, 2006
By Kyoko NAKAGAWA

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Signature

SPECIFICATION

CHIP TYPE LED

TECHNICAL FIELD

The present invention relates to a chip type LED comprising a light emitting diode chip as a light source and a transparent package hermetically sealing the light emitting diode chip.

BACKGROUND ART

Fig. 4 is a perspective view showing a prior art chip type LED. The chip type LED 1 includes an insulating substrate 2 in the form of a chip, a pair of terminal electrodes 3 and 4 formed on an upper surface of the insulating substrate, and a light emitting diode chip 5 mounted on the terminal electrode 3 with the anode electrode 5b oriented upward and the cathode electrode 5a oriented downward for electrical connection to the terminal electrode 3. The anode electrode 5b is electrically connected to the terminal electrode 4 by e.g. wire bonding using a non-illustrated thin metal wire. A transparent package 6 for hermetically sealing the light emitting diode chip 5 is provided on the upper surface of the insulating substrate 2 (See Patent Document 1).

Conventionally, when a plurality of chip type LEDs having the above-described structure is used as a backlight source for key switches arranged in matrix in a cell phone A, the chip type LEDs 1 are arranged on a circuit board C below the key

switches B at positions between the key switches B, as shown in Fig. 5. With this arrangement, the key switches B are illuminated with the light emitted laterally from the side surfaces of the packages 6 of the chip type LEDs 1.

Patent Document 1: JP-A-H10-50734

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

In the above-described chip type LED 1, most of the light generated from the light emitting diode chip 5 is emitted laterally through the side surfaces of the light emitting diode chip 5. However, part of the light is emitted upward through the anode electrode 5b on the upper surface. Therefore, the amount of light emitted through the side surfaces of the light emitting diode chip 5 is reduced by as much as the amount of light emitted upward through the anode electrode 5b on the upper surface.

In other words, the illumination for the key switches B becomes weak by as much as the amount of light from the light emitting diode chip 5 which is emitted upward through the anode electrode 5b on the upper surface.

Recently, therefore, in using the chip type LED 1 as a backlight source, a recess is formed at the upper surface of the package body 6 so that the light emitted upward through the anode electrode 5b on the upper surface of the light emitting diode chip 5 is refracted on the recess to travel laterally.

However, to provide such a structure, thickness enough

for forming a recess need be ensured between the upper surface of the package 6 and the upper surface of the light emitting diode chip 5. Therefore, the thickness for providing the recess is added to the height H0' of the package 6, which results in an increase in the height H' of the entire chip type LED 1. Therefore, the chip type LED for use as a backlight source cannot be reduced in thickness.

It is, therefore, an object of the present invention to solve the above-described problems and to provide a thin chip type LED usable as a backlight source.

Means for Solving the Problems

To achieve the above object, the chip type LED according to claim 1 of the present invention comprises an insulating substrate, a light emitting diode chip mounted on an upper surface of the insulating substrate, and a transparent package provided on the upper surface of the insulating substrate to hermetically seal the light emitting diode chip. The light emitting diode chip, including an anode electrode and a cathode electrode, is mounted on the upper surface of the insulating substrate with the anode electrode of the chip oriented downward and the cathode electrode of the chip oriented upward.

Claim 2 of the present invention is characterized in that, in the chip type LED of claim 1, the light emitting diode chip further includes a light emitting layer arranged adjacent to the cathode electrode, while also including a side surface inclined inwardly as the side surface extends from the cathode

electrode toward the anode electrode.

Claim 3 of the present invention is characterized in that, in the chip type LED of claim 1 or 2, the upper surface of the insulating substrate is made while at least around the light emitting diode chip.

Advantages of the Invention

The light emitting diode chip includes an opaque substrate on the cathode electrode side.

Therefore, by mounting the light emitting diode chip on the upper surface of an insulating substrate so that the anode electrode of the light emitting diode chip is oriented downward whereas the cathode electrode is oriented upward, the substrate of the light emitting diode chip prevents the light generated at the light emitting layer of the light emitting diode chip from being emitted upward from the cathode electrode side.

In this way, according to the present invention, the upward light emission through the upper surface of the light emitting diode chip is prevented, so that the lateral light emission through the side surface of the light emitting diode chip is increased. Therefore, unlike the prior art structure, the provision of a recess at the upper surface of the package for the light emitting diode chip can be eliminated. Therefore, the height of the package, and hence the height of the entire chip type LED can be reduced so that the LED can be advantageously used as a backlight source for a key switch of a cell phone, for example.

With the structure of claim 2, while keeping the area of the light emitting layer in the light emitting diode chip relatively large, the light generated at the light emitting layer can be emitted through the inwardly inclined side surface without significant attenuation. Therefore, the amount of light emitted laterally is considerably increased.

Further, with the structure of claim 3, the light emitted from the light emitting diode chip toward the insulating substrate is reflected by the white color, whereby the amount of light which travels laterally is further increased.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing a chip type LED according to an embodiment of the present invention.

Fig. 2 is a sectional view taken along lines II-II in Fig. 1.

Fig. 3 is a sectional view showing the chip type LED used as a backlight source for a key switch.

Fig. 4 is a perspective view showing a prior art chip type LED.

Fig. 5 is a perspective view showing an example of application of the prior art chip type LED.

DESCRIPTION OF SIGNS

11: chip type LED

12: insulating substrate

13, 14: terminal electrode

15: light emitting diode chip

15a: cathode electrode of light emitting diode chip

15b: substrate of light emitting diode chip

15c: n-type semiconductor layer of light emitting diode chip

15d: light emitting layer of light emitting diode chip

15e: p-type semiconductor layer of light emitting diode chip

15f: anode electrode of light emitting diode chip

16: package

17: metal wire

18: white color film

BEST MODE FOR CARRYING OUT THE INVENTION

A preferred embodiment of the present invention will be described below with reference to Figs. 1 and 2.

Indicated by reference sign 11 in the figures is a chip type LED according to an embodiment of the present invention.

The chip type LED 11 comprises an insulating substrate 12 which is in the form of a chip having an upper surface formed with a pair of terminal electrodes 13 and 14, a light emitting diode chip 15 mounted on the upper surface of the insulating substrate 12, and a transparent package 16 provided on the upper surface of the insulating substrate 12 to hermetically seal the light emitting diode chip 15.

The light emitting diode chip 15 comprises a substrate 15b made of e.g. silicon and having a surface on which a cathode

electrode 15a is provided and another surface on which an n-type semiconductor layer 15c, a light emitting layer 15d, a p-type semiconductor layer 15e and an anode electrode 15f are provided one upon another.

The light emitting diode chip 15 is so designed that the n-type semiconductor layer 15c has a relatively small thickness whereas the p-type semiconductor layer 15e has a relatively large thickness, so that the light emitting layer 15d is positioned relatively close to the cathode electrode 15a.

Further, the light emitting diode chip 15 is so designed that the dimension D1 at the cathode electrode 15a on one surface side of the chip is larger than the dimension D2 at the anode electrode 15f on the other surface side of the chip. Therefore, the side surface 15' of the light emitting diode chip 15 is inclined inwardly as it extends from the cathode electrode 15a side toward the anode electrode 15f side.

The light emitting diode chip 15 is mounted on the insulating substrate 12 with the cathode electrode 15a of the light emitting diode chip 15 oriented upward and the anode electrode 15f oriented downward so that the anode electrode 15f is electrically connected to the terminal electrode 13 by die bonding. The cathode electrode 15a on the upper surface of the light emitting diode chip 15 is electrically connected to the terminal electrode 14 by wire bonding using a thin metal wire 17, for example.

With this arrangement, when light is generated at the light emitting layer 15d due to the energization of the light emitting diode chip 15, the substrate 15b prevents the light from being

emitted upward through the upper surface of the light emitting diode chip 15. Therefore, almost all of the generated light is emitted laterally through the side surface.

Therefore, unlike the prior art structure, the provision of a recess at the upper surface of the package 16 hermetically sealing the light emitting diode chip 15 can be eliminated. Accordingly, the thickness between the upper surface of the package 16 and the upper surface of the light emitting diode chip 15 can be reduced. As a result, the height H0 of the package 16, and hence, the height H of the entire chip type LED 11 can be reduced. In other words, the thickness of the chip type LED 11 can be reduced.

In this way, the chip type LED 11 according to the present invention can laterally emit light and have a small thickness. Therefore, when the chip type LED is used as a backlight source for key switches B of a cell phone A by mounting the LED on a circuit board C below the key switches B at a position between the key switches B similarly to the instance shown in Fig. 5, the spacing S between each of the key switches B and the circuit board C can be reduced, as shown in Fig. 3. Therefore, the cell phone can be reduced correspondingly in size and weight.

Further, while the light emitting layer 15d of the light emitting diode chip 15 is positioned relatively close to the cathode electrode 15a defining the upper surface of the light emitting diode chip 15, the side surface 15' of the light emitting diode chip 15 is inclined inwardly as it extends from the cathode electrode 15a toward the anode electrode 15f. With this

arrangement, while keeping the area of the light emitting layer 15d relatively large, the light generated at the light emitting layer 15d can be emitted out of the inwardly inclined side surface 15' without significant attenuation. Therefore, the amount of light emitted laterally can be increased.

Part of the light emitted laterally from the side surface 15' of the light emitting diode chip 15 reaches the upper surface of the insulating substrate 12. Therefore, the upper surface of the insulating substrate is provided with a white color film 18 at the portion which is reached by the light from the light emitting diode chip 15, i.e. the portion around the light emitting diode chip.

With this arrangement, the light reaching the upper surface of the insulating substrate 12 is reflected by the white color film 18 to travel laterally, whereby the amount of light which travels laterally is further increased.

Instead of providing the white color film 18, the upper surface of the insulating substrate 12 may be made white.